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**Joint Engineering Data Management Information Control Systems/
Computer-Assisted Data Acceptance
(JEDMICS/CADA)
Final Report**

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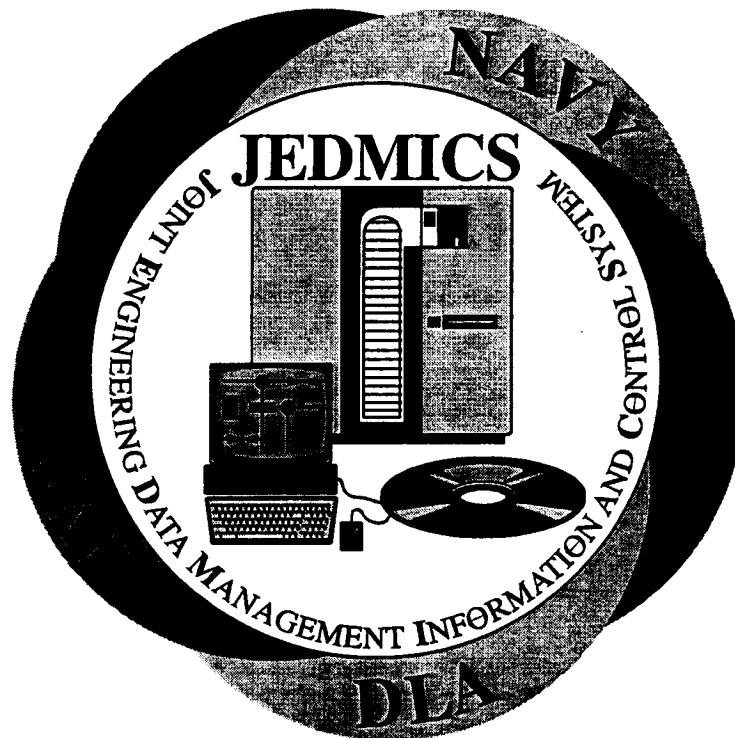
Prepared By:

ACCURATE Information Systems, Inc.
Meridian Center 1
2 Industrial Way West
Eatontown, New Jersey 07724

The views, opinions, and findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy, or decision, unless designated by other documentation.

***Joint Engineering Data Management Information
And Control System/
Computer-Assisted Data Acceptance
(JEDMICS/CADA)***

***Joint Engineering Data Managment
Information Control Systems/
Computer-Assisted Data Acceptance
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Final Report***



15 November 1996

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EXECUTIVE SUMMARY

ACCURATE Information Systems, Inc. (ACCURATE), under contract with the Program Manager Joint Computer-aided Acquisition and Logistics Support (PM JCALS), with funding and direction from the CALS (A&T), and the Electronic Data Interchange (EDI) Office of the Under Secretary of Defense (OUSD), developed and field tested Computer-Assisted Data Acceptance (CADA) tools for automating the acceptance of CALS Raster Type 1 data. Development of these tools was cooperative effort between ACCURATE and the Services who provided over 15,000 images and valuable input in the field testing of the CADA tools, as well as recommendations for the automated analysis of specific image and Identification Data (ID) elements.

The CADA tools provide the automated Quality Assurance (QA) of CALS-formatted engineering drawing data for quality specific to legibility and reproducibility of the drawing. The CADA tools also provide automated comparison of the key ID within the body of the drawing with the equivalent CALS ID header data. Extensive laboratory testing of the CADA tools was performed during the last few years at the laboratory level and in field tests by the Services.

The Navy was an active participant in field testing the CADA tools, and because of those successes, the Joint Engineering Data Management Information Control Systems (JEDMICS) Program Office funded this effort to expand the CADA capabilities. The CADA interface to JEDMICS Permanent or Pending¹ is via the JEDMICS 2.5 Application Programming Interface (API). This API access allows the operator to initiate a query to input from Permanent and to input from or output to Pending. JEDMICS/CADA, in unattended mode, provides format validation (e.g., C4, CALS Type 1/2 or TIFF 6), image quality analysis, and key identification (ID) verification of the engineering drawing digitized data.

This report describes the three-phased task accomplishments in the analysis, development, and testing of the JEDMICS/CADA System.

The Phase 1 analysis was a cooperative effort between ACCURATE and JEDMICS Program Office technical personnel. Technical meetings were held to analyze the JEDMICS input and output capabilities and the JEDMICS Application Programming Interface (API) for interfacing CADA to JEDMICS. The results of these meetings was a draft Functional Description (FD) document² that formed the basis of the application of CADA to JEDMICS.

The FD was approved by the JEDMICS Program Office, Phase 2 development and testing design specifications were prepared and the API/CADA design effort began. The CADA software was modified to allow the Identification Data (ID) module to process JEDMICS Index information, provide error

¹ Permanent Storage and Pending Storage are referred to as Permanent and Pending respectively throughout this report.

² The original FD, plus an Addendum that shows the changes authorized by the JEDMICS Program Office, has been delivered with this report.

handling and reporting for JEDMICS, and modification of the CADA end-user interface. A number of additions were made during this Phase 2 effort that provided enhancements for adding an option to turn OFF the strict revision information checking of the revision zone information and allow only matching the revision letter to the revision letter contained in the index information. Another feature allowed reporting of image quality rejects by zones for any size drawing. Also added were, capabilities to recognize and report C4 format and compression problems.

An addition to the original tasker also provided fielding of four JEDMICS/CADA prototype systems at JEDMICS sites.

A demonstration of the JEDMICS/CADA system and presentation was given at the JEDMICS Users Conference that was well received.

Phase 3 was the last phase that involved preparation and delivery of the JEDMICS/CADA documentation and software with one license for use of the Commercial-Off-The-Shelf (COTS) Products. The documentation consists of one hard copy and 3 1/2" diskette(s) of the *End Users Manual*, *Computer Operator's Manual*, *Functional Description*, and *Final Report*. The software, delivered on a 1/4" data cartridge, consists of the Source Code and three Commercial Off-the-Shelf (COTS) products. The Executable Software Package was delivered on 3-1/2" diskettes.

DISCLAIMER

The use of trade names in this document and/or discussion of a particular product does not constitute an endorsement or approval of the use of such commercial equipment. This document may not be cited for the purpose of advertisement.

***Joint Engineering Data Management Information Control Systems/Computer-Assisted Data Acceptance
(JEDMICS/CADA) Final Report***

1 INTRODUCTION

1.1 Background

The Computer-Assisted Data Acceptance (CADA) tools were developed for the Department of Defense (DoD) to automate Quality Assurance (QA) of CALS Raster Type 1 data. Extensive field testing of the tools was performed by the Joint Services. The Joint Engineering Data management Information Control Systems (JEDMICS) Program Office authorized evaluation of the tools at the JEDMICS Louisville, KY. site, and as a result of the tests initiated this task to add enhancements that will benefit JEDMICS and provide a non-intrusive interface between CADA and JEDMICS via the JEDMICS API. In addition, other tasks were initiated to provide Beta testing of the enhanced JEDMICS/CADA features at four JEDMICS field sites. All of the sites have been upgraded to the same JEDMICS/CADA version delivered under this contract (JEDMICS/CADA version 1.0).

The development of the first automated tools (CADA) was performed in close cooperation with the Services' users who identified two key areas for automating the acceptance of CALS digital data. These areas were:

- the quality of the image data from a legibility and reproducibility standpoint, and
- the accuracy and quality of the Identification Data (ID) within the body of the engineering drawing and the associated CALS header.

Since the application of automated algorithms and techniques cannot totally replace human decision making, the objectives of the project, from its beginning in 1991, have been clear. The automated software tools must be able to recognize the readily identifiable poor quality images and ID in order to enhance the operators' ability to accept quality CALS digital data in a more efficient manner at a reduced cost to the Government.

This report will identify and describe the engineering analysis, software design, testing and fielding steps that occurred in the development of the enhanced JEDMICS/CADA System. In addition, this report will identify the Commercial Off-the-Shelf (COTS) products and the run-time licenses required by JEDMICS/CADA. It will also describe the telephone support available in FY 97 for the users in the field. Each of the three Phases of this contract; analysis, development/testing, and documentation will be discussed in Sections 5 through 7 of this report.

1.2 Purpose

This report provides the readers with a summary of the accomplishment of this task in the development and fielding of the JEDMICS/CADA System.

1.3 Scope

This report includes a reference section of documents delivered under this JEDMICS/CADA development effort, a summary of the accomplishments achieved during the analysis and development Phases, and the site fielding effort that occurred during this contract period. An overview of the documentation prepared and submitted during the last Phase is also presented, as well as conclusions reached and recommendations proposed.

2 REFERENCES

2.1 Project References

The following references include the Project Contract and Task Assignment Plan(s), Applicable Standards, and Proprietary Vendor Documentation.

2.1.3 Applicable Standards

MIL-STD-1840A,B	Automated Interchange of Technical Information
MIL-PRF-28002A,B	Raster Graphics Representation in Binary Format
MIL-HDBK-59B	DoD CALS Implementation Guide
ANSI Y14.1-1980	Drawing Sheet Size and Format

2.1.4 Proprietary Documentation

The following COTS products are integrated into the JEDMICS/CADA tools and licenses are required to use these software packages. Appendix A contains information on the procurement of the run-time licenses.

Vendor Product	Usage	Vendor
NestorReader™	ICR Product	NCS Recognition
ScanFix™	Software Libraries for line removal and deskewing	TMSSequoia
UniSoft™ Imaging Utilities	Imaging Software Libraries for Compression, rotation and display of image data.	UniSoft Imaging

3 GLOSSARY OF TERMS

API	Application Programming Interface
CADA	Computer-Assisted Data Acceptance
CALS	Commerce At Light Speed
CECOM	Communications-Electronics Command
COTS	Commercial-off-the-shelf
CR	Compression Ratio
DLA	Defense Logistics Agency
DoD	Department of Defense
DSREDS	Digital Storage and Retrieval Engineering Data System
EDCARS	Engineering Data Computer Assisted Retrieval System
EDMICS	Engineering Data Management Information and Control System
GUI	Graphical User Interface
ICR	Intelligent Character Recognition
ID	Identification Data
I/O	Input/Output
JCALs	Joint Computer-aided Acquisition and Logistic Support
JEDMICS	Joint Engineering Data Management Information Control Systems
MICOM	Missile Command
NIST	National Institute of Standards and Technology
OUSD	Office of the Under Assistant Secretary of Defense
OCR	Optical Character Recognition
PDL	Page Description Language
PM	Program Manager
PM JCALS	Project Manager Joint Computer-aided Acquisition and Logistic Support
QA	Quality Assurance
SOW	Statement of Work

4.0 APPROACH

The approach taken, as proposed, was to initially define the functional objectives and scope of this task in preparation of a guiding document. The preparation of this document, the Functional Description (FD), required close cooperation between the ACCURATE design team, the JEDMICS Program Office, and the JEDMICS Prime Contractor. The analysis Phase, resulted in acceptance of the FD. Once the FD was accepted, Phase 2 began.

Phase 2 required development of design specifications in accordance with the FD, establishment of schedules and assignment of the task to the design personnel. A design configuration control system was established to track the design, reviews, and testing at various stages of the software development. The software design began and the software and hardware required for the task was ordered.

An additional task assignment resulted in installing a prototype system at the JEDMICS site located at Ft. Monmouth. This provided the user feedback during the initial testing of the API when interfacing to Permanent. It also afforded an earlier than anticipated evaluation of the tools in automated QA of the migrated images from the Digital Storage and Retrieval Engineering Data System (DSREDS) to JEDMICS. The JEDMICS Program Office Project Manager brought other users in and three more sites were added. The additional sites and four additional enhancements extended the original Phase 2 schedule by two months.

The final Phase involved completion of testing and preparation of the supporting documentation in accordance with DoD-STD-7935A for delivery to the Government with the JEDMICS/CADA software source code and executable software.

Each Phase will be addressed in the following sections.

5 ANALYSIS AND DESIGN REQUIREMENTS - PHASE 1

This initial Phase was scheduled as a two month period of joint teamwork between the ACCURATE design team and the designated JEDMICS Program Office technical team. The output was a high level Functional Description (FD) document that defines the approach and requirements for applying the CADA tools to JEDMICS.

5.1 Technical Meetings

Two meetings were held at the JEDMICS Program Office which consisted of briefings by ACCURATE on the existing capabilities within CADA and technical discussions with regard to what the JEDMICS users requirements of the CADA tools were and how they would be integrated into JEDMICS. This required analyzing the overall capabilities for inputting from and outputting to JEDMICS and how this might be done without impacting JEDMICS' current daily operations.

The JEDMICS Application Program Interface (API) was reviewed in some depth with the JEDMICS personnel. The basic approach that the JEDMICS Program Office outlined, after these discussions, was to utilize the API for CADA to interface to JEDMICS Pending and Permanent. These meetings formed the basis for preparation of the Functional Description (FD) document.

5.2 The Functional Description Document

A draft FD was prepared and submitted to the JEDMICS Program Office for review by their technical personnel. After some delay, another meeting was held with JEDMICS personnel and ACCURATE was authorized to proceed with ordering the basic support software and hardware that normally would have been ordered at the beginning of Phase 2. The final FD was accepted in November by the JEDMICS Program Office and the Phase 2 kick-off was initiated. The Phase 1 Schedule and Milestones are shown in Section 5.4.

5.3 Conversion Software for CADA

Two vendors were contacted before selecting Phenomenon. The software, with one license, was obtained and both in-house data types and data from some of the Services sites were obtained for this design effort. It became apparent, after a great deal of testing, that the software was not reliable for this application. The design team then analyzed the C4 specification carefully and developed the C4 conversion code, which was then tested and implemented into the JEDMICS/CADA System.

5.4 Phase 1 Schedule and Milestones

Phase 1 schedules and major milestones are shown in Table 1. The original schedule and actual are shown.

Table 1. Phase 1 Schedule and Milestones

TASKS - Phase 1	Aug '95	Sept '95	Oct. '95	Nov '95	Dec '95	Jan '96	Feb '96	Mar '96	Apr '96	May '96	June '96	July '96	Aug '96	Sep '96	Oct '96
SCHEDULE ----->	0	→													
PH. 1 "Kick-Off"	0														
Technical Meetings		X	X												
Prep. Functional Description.		→													
Procure C4 Conversion Software	→													
FD Acceptance				X											

6.0 DEVELOPMENT AND TESTING OF THE JEDMICS/CADA REQUIREMENTS - PHASE 2

This Phase addressed the detailed design, implementation and testing of the JEDMICS/CADA requirements requested by the Program Office and funded by two additional tasks.

6.1 Design Specifications

This Phase involved a review of the Functional Description and a breakdown of the JEDMICS/CADA data structures modules which would be impacted. High level designs were written for the Permanent and Pending access, and for the processing of large format drawings.

The original CADA System required human interaction in order to perform a run. JEDMICS/CADA required the ability to run unattended. For this reason, detailed analysis was performed on the CADA control flow and required changes were documented.

To support the new features of JEDMICS/CADA, enhancements were made to the existing Evaluation Status Report, and two new reports were designed.

6.2 CADA Input/Output Modification for JEDMICS API (023)

Once the design was complete, the JEDMICS API was obtained, and the JEDMICS/CADA data structures were enhanced to account for the additional data elements. Initial development used API version 2.0. The code was later upgraded to version 2.5.

6.3 CADA /JEDMICS Permanent Access (023)

The first portion of the JEDMICS access design to be implemented was for reading from Permanent. This involved additions to the JEDMICS/CADA input module, the user interface, and JEDMICS/CADA status reporting.

One issue still remaining is the maximum query hit limit. This value can be set through the API and specifies the maximum number of images which can be returned by a query. During normal JEDMICS user activities, the number of images per query is very low. During JEDMICS/CADA processing, the number of images requested per query is very high. This type of request has an impact on the cursor¹ which is maintained within the data base server.

It is suspected that performance may be impacted if there are many simultaneous users. For these reasons, the maximum query hit limit is set at 20,000 (the default in JEDMICS/CADA is 1,000). This number can be increased or decreased by the JEDMICS/CADA user. However, to account for this limit,

¹ The cursor refers to the query results received by the data base server.

JEDMICS/CADA provides additional fields so a user can specify precise query criteria which will yield no more than the maximum allowable number of images.

The permanent query criteria screen allows the user to specify the query using any combination of a drawing number, drawing CAGE code, drawing size, in-date, and/or platter ID. In addition, the user must specify a query name which is used solely within JEDMICS/CADA for tracking purposes.

JEDMICS/CADA will extract the images, perform evaluation, and produce an evaluation report. JEDMICS/CADA also has a sub-batch size which is used to limit the number of images which are being processed at one time. The sub-batch limit defaults to 100, but the JEDMICS/CADA user can change this value. The only limiting factor for this size is available disk space on the JEDMICS/CADA workstation.

6.4 JEDMICS/CADA Pending Access

The second piece of the JEDMICS access was to input from and output to JEDMICS Pending. This involved enhancements to the input and output module, the user interface, the internal flow control for JEDMICS/CADA, JEDMICS/CADA status reporting and the addition of a new Pending status report.

This option will allow a user to extract a batch from Pending and perform automated evaluation and then insert the results back to Pending. In order to do this, the user is prompted to enter a valid Pending batch ID. In addition the user must assign a name to the query which is used for JEDMICS/CADA internal tracking.

To use this feature, the JEDMICS/CADA account on JEDMICS must have read and write privileges to Pending.

There have been a number of limitations which have been encountered during this implementation. Currently, there is no means to modify the QA flags or add information for an existing batch. For this reason, JEDMICS/CADA must create a new batch and re-insert the images and index information. The problem caused is that an operator must manually remove the original batch. When the JEDMICS user reviews the new batch created by CADA, error messages will be displayed indicating that there is a duplicate entry for the image. This is caused when the original batch is still present.

Because the API does not allow additions to an existing batch and some in restricts sub-batch sizes, if there are more than 100 images in the original batch, some in is forced to create a new batch in Pending for each sub-batch it processes.

6.5 CADA Enhancements for JEDMICS Applications (023, 026, 028)

A number of enhancements were originally proposed. However, as the development proceeded and additional inputs were received from the JEDMICS users, the Program Office issued additional changes to the Statement of Work (SOW) to add other enhancements. These will be addressed in this section

although the deliverable may be under another task, but commensurate with this task order delivery. The task orders were 023, 026, and 028 respectively.

6.5.1 Implement the Large Format Drawing Migration Capability (023)

This task was started but was canceled by the Program Office since additional enhancements took priority. The identified sub-tasks were:

- add automated identification for J, F, G, and H size drawings,
- modify the JEDMICS/CADA program control/data structure to handle the F, G, and H sizes,
- add index checks for supplementary drawing number blocks,
- modify the header information for JEDMICS acceptance, and
- modify the JEDMICS/CADA output for logging errors and reporting modifications.

6.5.2 Indexing and C4 Data QA (023)

This sub-task included the following:

- internal JEDMICS/CADA Identification Data (ID) module modifications to allow for processing JEDMICS headers,
- fine tuning of the separate revision block processing,
- modifications to the ID output information for error handling and reporting, and
- modifications to the JEDMICS/CADA end-user interface.

6.5.3 Revision Block Zone Options (028)

This option allows the operator to turn off strict revision information checking. The sub-tasks include the following:

- add operator option to select this option as "ON" or "OFF" in the Options>Evaluation screen
- add the capability to ignore revision zone information contained in the separate revision block of the image when ON is selected, and
- only match the revision letter(s) to the revision letter(s) contained in the index information revision field. This will ignore any zone information present with the revision on the image.

6.5.4 Rights Block Option (028)

This option would have allowed the operator to ignore image quality rejects that occur only within the Rights Block area of the image. This option was replaced with the Intelligent Rotation option.

Initial testing with CECOM revealed that images which were scanned and input to JEDMICS were usually scanned at a 90 degree angle. For this reason, JEDMICS/CADA performed an automatic 90 degree rotation when receiving images from JEDMICS.

After the beta version of JEDMICS/CADA was fielded it became apparent that the images in the JEDMICS repository did not follow this 90 degree rotation. Because the JEDMICS index information does not contain the correct rotation information and because the JEDMICS/CADA zone reporting and index verification depends on the image being correctly rotated the Intelligent Rotation software had to be developed.

This code attempts to find the correct rotation for the image and set the correct rotation for processing within JEDMICS/CADA. Because JEDMICS does not store the rotation information, this information cannot be output to JEDMICS and it is lost.

6.5.5 Rejects by Zones Reporting (028)

This feature provides for identifying quality rejects by zones within the image area and include the location information in the Evaluation Report. The sub-tasks include the following:

- investigate options that effectively identify zones within all size images,
- implement the software design to identify the rejects within the zones, and
- add the reject zones to the Evaluation Report.

6.5.6 C4 Output Report Features (028)

This enhancement adds specific C4 format problems and bad compression data information to JEDMICS/CADA format verification and reports the results in two reports. The design sub-task includes the following:

- develop software to identify format problems within the header or the compressed image area,
- output the identified errors in the appropriate report, and
- format the reports to best indicate the identified problems.

6.6 Prototype Laboratory Testing (023)

This was an on-going effort which spanned Phases 2 and 3. As the software modules were developed they were tested by the designer and then turned over to an independent tester for final testing in the laboratory. Some of the sub-tasks included:

- acquire and load data from the field and prepare representative types of data as a suite of test data,
- evaluate each of the design enhancement modules through appropriate testing, and

- demonstrating the prototype prior to fielding under task 028.

6.7 Requirements Papers (028)

This task involved preparing and submitting the following three papers :

- *Recognition and Reporting Drawing Title to JEDMICS Index Data Base,*
- *Approach for Sending JEDMICS/CADA Reject Images to Pending Storage for Manual Review, and*
- *JEDMICS/CADA Quality Assurance (QA) of Output to JEDMICS..*

6.8 Site Prototype Implementation (026 and 028)

Prototypes were installed and training provided at the following four sites. Task 026 was the initial task to install and provide automated image QA of the migrated data to the CECOM JEDMICS site. As a result of this implementation three additional sites were fielded later under task 028.

- CECOM/JEDMICS Site at Ft. Monmouth, NJ 9/10/96
The first installation, under task 026, was in June via API 2.0 and after JEDMICS was moved and upgraded to API 2.5, another installation was made in early September. ACCURATE has also used the system in final testing .
- Warner Robins/JEDMICS Site - Robins APB, GA. 8/15/96
- MICOM/JEDMICS Site - Redstone Arsenal, GA (9/10/96
- Point Hueneme/JEDMICS Site - Oxnard, CA. (11/4/96) *Note: This installation occurred under task 028.*

6.9 Performance Evaluations

Limited performance evaluations were run on the upgraded SPARC 20 with 64 MB of RAM and a 150 MHz processor. In-house testing was performed using a set of 700 images which was a product of the previous field tests. For each of these images, field operator decision has been logged. This test set was compiled in order to test specific evaluation features within JEDMICS/CADA, and therefore, contains a high percentage of poor quality images, images with handprinted ID characters, non-ANSI image layout, and Technical Manual (TM) pages with no image borders.

The current test results of JEDMICS/CADA have been compared to the known operator decisions and appear in tables 2 through 5. Tables 2 through 4 show Image Quality Results for three different settings. The New Contractor setting is a more strict evaluation than the Legacy setting. It is intended to be used when high quality is required. The Entire Image option performs evaluation on the entire scan area, whereas the Within Borders setting checks image quality only within the found image borders.

Table 2. Image Quality - Legacy Within Borders

	Correct Accepts	Correct Rejects	False Accepts	False Rejects	Total
Number of Images	583	22	20	75	700
Percentage	83.28%	3.14%	2.85%	10.71%	100%

Table 3. Image Quality - New Contractor - Entire Image

	Correct Accepts	Correct Rejects	False Accepts	False Rejects	Total
Number of Images	422	162	57	58	700
Percentage	60.28%	23.14%	8.14%	8.28%	100%

Table 4. Image Quality - New Contractor - Within Borders

	Correct Accepts	Correct Rejects	False Accepts	False Rejects	Total
Number of Images	418	98	135	49	700
Percentage	59.71%	14.00%	19.23%	7.00%	100%

Table 5 shows the results for the ID checks between the Key ID from the image index and the Key ID found within the image.

Table 5. ID Verification

	Correct Accepts	Correct Rejects²	False Accepts	False Rejects	Total
Number of Images	434	44	0	222	700
Percentage	62%	6%	0%	32%	100%

Run-time testing of input, output and evaluation was also performed. These tests were conducted at the CECOM JEDMICS site. At the time of this report, write access to Pending was not allowed, so the testers were not able to conduct output to Pending run-time tests. The results of these tests are shown in 6.

² These images were rejected for ID and also were rejected for image quality in the lower right zone (title block area). These images fall into a category where manual inspection is required.

Table 6. Typical Performance Times

CATEGORY	FUNCTION	NO OF IMAGES OR IMAGE SIZE	TIME (IN MINUTES:SECONDS)
INPUT	Directory	5	0:12
		100	1:38
	Tape	5	0:37
		100	5:02
	JEDMICS Permanent (Query)	100	9:05
	JEDMICS Permanent (Load)	100	3:30
	JEDMICS Pending (Query)	100	0:06
	JEDMICS Pending (Load)	100	3:40
	AUTOMATED EVALUATION Image Only (Entire Image)	5	0:10
		100	3:41
	AUTOMATED EVALUATION Image Only (Within Borders)	5	1:07
AUTOMATED EVALUATION		100	31:21
	Image Validation, ID	5	2:32
DISPLAY IMAGE LIST		100	46:05
	With Alpha Numeric Sort, Document count and Image Size count	100	0:02
OUTPUT	Directory	5	0:01
		100	0:28
	Tape	5	0:55
		100	9:00

The sample batches used for the performance times consisted of five or 100 images of varying image size and quality.

6.10 Phase 2 Schedule and Milestones

The schedule and major milestones of Phase 2 are shown in Table 7. Several new features, bug fixes, and performance improvements were incorporated into the software releases during this period.

Table 7. Phase 2 Schedule and Milestones

TASKS - Phase 2	Aug '95	Sept '95	Oct. '95	Nov '95	Dec '95	Jan '96	Feb '96	Mar '96	Apr '96	May '96	June '96	July '96	Aug '96	Sep '96	Oct '96	Nov '96
SCHEDULE ----->				●									→			
PH. 2 "Kick-Off"				X												
Design Specifications				→												
API / CADA I/O Mods.					→											
Permanent Read Only							→									
Pending R/W								→						→		
C4 Convr. Sftwr. COTS					→											
C4 Convr. Sftwr. Dev.						→										
JEDMICS / CADA ENHANCEMENTS																
Index & C4 Data QA							→									
Rev. Blk. Zone Opt.															→	
Rights Blk. Opt.															→	
Rejects by Zones Rep.															→	
C4 Output Reports.															→	
Prototype Lab. Tests																
Requirements Papers																
Site Prototype Implements													X	X	X	
Performance Evaluations													X	XX		X
												→			→	

7.0 UPGRADE PROTOTYPE AND DOCUMENTATION - PHASE 3 (023)

The final Phase was to upgrade the field sites from the prototype version of software to the version that is delivered with this report and to complete the documentation for delivery.

7.1 Software Upgrades

Each of the sites software was upgraded to this delivered version. These JEDMICS sites have the COTS licenses required for operation.

7.2 Documentation

The documentation delivered under this task includes one set of hardcopy and one set of electronic copy in Microsoft Word format on 3 1/2 " diskettes. The documentation delivered includes:

- 1 ea. *JEDMICS/CADA Functional Description*,
- 1 ea. *JEDMICS/CADA End Users Manual*,
- 1 ea. *JEDMICS/CADA Computer Operator's Manual*,
- 1 ea. *Final Report*, and
- 1 ea. Requirements Documents.
Recognition Of Image Drawing Title For Population In Permanent Storage
Approach for Sending JEDMICS/CADA Rejected Images to Pending Storage for Manual Review
JEDMICS/CADA Quality Assurance (QA) of Output from JEDMICS

7.3 Software

The software delivered under this task includes:

- 1 ea. JEDMICS/CADA Source Code Package
- 1 ea. JEDMICS/CADA Executable Software Package ³

7.4 Phase 3 Schedule and Milestones

The schedule and major milestone of Phase3 are shown in Table 8.

³ **Note:** The executable includes COTS software with licenses for use on one Sun or Sun compatible workstation.

Table 8. Phase 3 Schedule and Milestones

TASKS - PH 3	Aug '95	Sept '95	Oct. '95	Nov '95	Dec '95	Jan '96	Feb '96	Mar '96	Apr '96	May '96	June '96	July '96	Aug '96	Sep '96	Oct '96	Nov '96
SCHEDULE --->																
PH. 3 "Kick-Off"														X		
Prepare Documentation																
End Users Manual																
Computer Op. Manual																
Generate Source Code on Media																
Generate Executable & COTS on Media																
Prepare Final Report																
Ship Deliverables																
																X

8. CONCLUSIONS

The basic CADA software tools were enhanced to produce the JEDMICS/CADA system that utilizes the JEDMICS API for access to the JEDMICS Pending and Permanent in a non-intrusive manner. This system provides read/write access to Pending and read only access to Permanent for automated format validation of and C4 data, automated image QA and Index validation. Additional features and operator options were added that included the following.

- A strict image QA of new data from weapon system contractors and a more lenient image QA of Government owned legacy data.
- An Option to “turn off” strict revision block checking and only allow matching the revision letter to the revision letter contained within the JEDMICS index information.
- Provide reporting of quality rejects by zones within the image area and C4 format problems such as corrupted or irregular header structure and bad compression data

8.1 Intelligent Rotation for C4 Data

The addition of the Prototype testing and the Intelligent Rotation capability replaced the addition of the Large Format Drawing Migration capability and the option to ignore image quality rejects within the Rights Block area of the image. A number of other operator options for data evaluation and output reporting were added as a result of feedback from the JEDMICS field sites and approved by the program office.

The fielding of four field sites with the JEDMICS/CADA prototypes was accomplished and these were updated to version 1.0 of the JEDMICS/CADA software. A briefing and demonstration of the JEDMICS/CADA system was given at the JEDMICS Users Conference. This was well received and initiated the Port Heuneme site fielding.

The fielding of the JEDMICS/CADA prototype at JEDMICS sites allowed early evaluation of the migrated data to Permanent via these tools and also allowed early testing that resulted in the addition of other operator options identified by the operators and approved by the JEDMICS Program Office. The JEDMICS/CECOM site API upgrade and moving of the site delayed the testing. An attempt to obtain test data from the other JEDMICS sites prior to the prototype installation was not very successful due to problems with obtaining access privileges, site down time due to system upgrades, and slow transfer times over the Internet for the image data. An ISDN line was added at ACCURATE, however this did not help since huge delays were imposed within the Government agencies between source and destination. The routing sometimes would go through as many as 14 Government drops between ACCURATE in New Jersey, and Warner Robins in Georgia.

Performance tests were conducted and the results appear in Section 6.9. The results, using the in-house test set, suggest that JEDMICS/CADA must now be run using the existing JEDMICS repositories and

data currently being received at these repositories. These results will give a better indication as to the operator acceptance.

One of the COTS products, ScanFix™, has a problem that occurs under certain conditions that results in their software exiting and not sending an error code to JEDMICS/CADA, thereby crashing the JEDMICS/CADA system. This occurs randomly and rarely, however the vendor has identified the problem and will correct it at no cost. ACCURATE will upgrade the software and the four sites within two weeks after receipt of the revised COTS product. A letter from the vendor is enclosed with this delivery.

9 RECOMMENDATIONS

9.1 Application of JEDMICS/CADA

In house and field testing of the JEDMICS/CADA system as well as feed back from the JEDMICS users indicates that the most practical and efficient application of JEDMICS/CADA are documented in Sections 9.1.1 through 9.1.3.

9.1.1 JEDMICS Output Data

It is recommended that the JEDMICS/CADA system be used to provide 100 percent Image QA and Index validation of all data that is output from JEDMICS. This will ensure that JEDMICS always provides quality data to their users. This will include bid-set data or any other data requested for output on media or future Internet or other communication means. The location of the image and Index files within the JEDMICS output server will be identified by JEDMICS/CADA prior to device output. JEDMICS/CADA will provide unattended image quality QA and index verification and prepare a report of the results. The operator can then review the rejected images and either override or expedite corrections of the rejected images prior to output to the identified media device. A requirements paper, *JEDMICS/CADA Quality Assurance of Output from JEDMICS*, which is a component of the 15 November 1996 delivery, addresses this approach in more detail.

9.1.2 JEDMICS Input Data

The second recommended application of JEDMICS/CADA is to provide automated C4 format and image compression validation, image QA, and key ID validation of the Index information for each image received from contractors as new data or locally scanned JEDMICS data. JEDMICS/CADA will retrieve the images and Index from Pending, perform automated QA, and output a new batch with the modified QA flags to Pending. The operator can then make the final acceptance of the input data prior to releasing the batch to Permanent.

9.1.3 JEDMICS Permanent Data

This recommendation would utilize JEDMICS/CADA to provide unattended image format and QA validation of all migrated data to Permanent. The image quality checks would flag those images with severe noise content, all black, or all white, and print out a report of the rejects for subsequent review by the QA operators. This selective evaluation is chosen against Permanent because full QA on Permanent would potentially identify a large volume of images which require human inspection

9.2 API Modifications

In order for JEDMICS/CADA to make the best use of the interface to JEDMICS, the following enhancement to the JEDMICS API are requested.

- JEDMICS/CADA requires an index element for each image which can be used to indicate that the image has been QA'd by JEDMICS/CADA. This would eliminate duplicate automated QA.
- JEDMICS/CADA currently must create a new batch on Pending for each Pending batch it evaluates and outputs to Pending. A better approach would be for JEDMICS/CADA to be able to modify the QA flags for the original batch on Pending.

The ability to modify index information for an existing Pending batch would eliminate the current requirement to create a new Pending batch and input and output all the index information by JEDMICS/CADA.

9.3 Add Features to JEDMICS/CADA

Inputs from the users and contractors, that are providing data types other than C4 to JEDMICS suggest that additional features should be incorporated into JEDMICS/CADA.

9.3.1 Output Converted Files

The JEDMICS/CADA system presently converts different type files to TIFF for internal processing. Some of the types include TIFF 6 tiled and untiled, CALS Type 1, and of course, CALS C4. This capability, to convert from any of these and other types to C4 exists, however the ability to output the converted files from JEDMICS/CADA has not been required until recently. It is recommended that this capability be added for future conversion of TIFF 6 tiles and untiled; CALS Type 1 to CALS C4 as a minimum. Some have asked that CALS IGES conversion to CALS C4 be added also. There may be other types that should be considered.

9.3.2 Image Clean Up Features

It has been suggested by some users that options to selectively clean up Government owned legacy data be added to JEDMICS/CADA. Some of the clean-up features that may be considered are as follows.

- Cropping - This option would automatically crop all noise outside the borders of engineering drawings on input to or output from JEDMICS Government owned engineering drawing data.
- Speckle Removal - This option would automatically removed image noise to automated image QA and ID validation on Government owned, legacy data.
- Rubber Band and Block Eraser Features - These interactive features would allow qualified operators to selectively clean up Government owned engineering drawing images as required. They would be used through the JEDMICS/CADA user interface.

9.4 User Survey of JEDMICS/CADA Capabilities

It is recommended that all potential JEDMICS users of JEDMICS/CADA be made aware of the existing and recommended capabilities of JEDMICS/CADA. They would then be asked to comment on the use of the existing features at their site, and recommend other features that may improve their use of JEDMICS/CADA at their JEDMICS site.

9.5 JEDMICS/CADA Configuration Control and Software Maintenance Support

It is anticipated that as the JEDMICS/CADA site users begin to actively use those tools for which they will be requesting changes or additions. These must be documented and tracked to assure that the additions be made that are in the best interest of JEDMICS PMO and all users. The COTS vendors will be updating their products and these revisions must also be under configuration control. Any software problems that occur over the next year must be documented and tracked. As later revisions to JEDMICS occur, the JEDMICS/CADA product must be compatible and if changes are required then these too must be under configuration control. It is recommended early consideration of establishing JEDMICS/CADA configuration control that addresses these possibilities.

9.6 Provision for Field Support for CADA

Limited telephone support under a separate task has been authorized but this will not be sufficient for software maintenance support if JEDMICS/CADA is to be widely deployed in the future.

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APPENDIX A

Commercial-Off-The-Shelf (COTS) Products

In order to use the JEDMICS/CADA executable software package it is required that run-time licenses be obtained for use of the COTS products. It is unlawful to use this package without obtaining the licenses. The Government does not endorse these COTS products and they may be used at the discretion of the user. Other equivalent COTS products may be substituted upon obtaining the source code from the Government. The COTS products that are incorporated into the JEDMICS/CADA executable software are shown below. The licenses may be obtained from IC&G Systems, the OEM distributor for these products, for use in JEDMICS/CADA or directly from the vendors.

APPLICATION	PRODUCT	VENDOR
OCR/ICR Software	NestorReader™ Library Part No. NR-CADA	NCST™ Recognition Products One Richmond Square , RI 02906 Attn.: David P. Wright
Imaging Library 1	ScanFix™ Library Part No. CADA-SF	TMSSequoia
Imaging Library 2	UniSoft Imaging Library Part No. USCADA-V6	Unisoft Imaging 4606 N. Britton Road, OK. 74075 Calvin Aiken
Source for Licenses:	Integrated Computer & Graphics Systems 809 East Redwood Court Highlands Ranch, CO. 80126 (303) 470-7262 (Tel or Fax)	

Disclaimer: The use of these COTS products does not constitute an endorsement or approval of their use. This software may not be cited for the purpose of advertisement. Any of these products may be replaced by equivalent products due to the availability of the JEDMICS/CADA source code.

